

(19) Japan Patent Office (JP)

(12) Unexamined Patent Publication Bulletin (A)

(11) Patent Application Publication No. H09-246796

(43) Laid-Open Disclosure Date: 19 September 1997

(51) Int.Cl. ⁶	Identification Symbols	JPO File Nos.	FI	Technical Indication
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H05K	13/04		H05K	13/04	P
B23P	19/00	302	B23P	19/00	302Q
Request for Examination: Not yet requested			Number of Claims: 1	FD	(Total of 5 pages)

(21) Application No.: H08-075241

(22) Application Date: 5 March 1996

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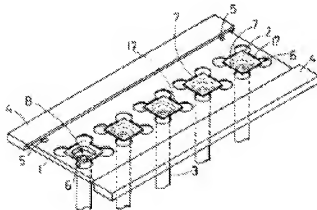
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(54) Title of the Invention: Work Positioning and Fixing Apparatus

(57) [Abstract]

[Problem] A work positioning and fixing apparatus, in which firstly, processing is enabled on the upper surface of a work; secondly, fixing and processing operations are performed at the site to prevent the occurrence of slippage of work position due to movement, and, thirdly, positioning is performed after lifting the work from the carrier, so as to allow for positioning of the work without being affected by deformation of the carrier.

[Means for solving the problems] First, a work positioning apparatus is made that has a carrier positioning and fixing mechanism and a work positioning and fixing mechanism inside the carrier. Second, work housing units on which reference sides are provided are formed on the carrier, through holes are bored, and work supports in which another work adsorption surface is set in parallel are provided underneath the through holes in the carrier to enable movement in a vertical and horizontal direction. Third, the work supports are adsorbed from below and are pressed against the reference side in the adsorbed state, and positioning is performed in the horizontal direction of the work.



(57) Claims

[Claim 1] A work positioning and fixing apparatus that comprises a carrier positioning and fixing apparatus and a work positioning and fixing apparatus inside the carrier, characterized in that work housing units are formed in which reference sides are provided on at least two edges thereof in the intersecting directions in the carrier, through holes are bored in the work housing units that are smaller than the work and through which the work supports can be passed and moved in the horizontal direction within a fixed range, work supports in which the other work adsorption surface is set horizontally are provided underneath the through holes of the carrier so that they can move vertically and horizontally, the work is adsorbed from underneath to the work adsorption surface as the work supports rise, the bottom surface of the work is lifted to a height that does not exceed the height of the reference sides of the work housing units, said work adsorption unit is moved in the horizontal direction in the adsorbed state so that it is pressed against at least two reference sides that are formed in the work housing units and, by bringing the work into contact with the reference sides, positioning is performed in the horizontal direction of work.

[Detailed Explanation of the Invention]

[0001]

[Technical Field of the Invention] This invention relates to an apparatus whereby work positioning and fixing is performed, and, primarily, it is intended for the purpose of developing an apparatus for performing positioning of a BGA (ball grid array) package, which is the work, in ball mounters for BGAs.

[0002]

[Prior Art] Conventionally, BGA ball mounting has been generally classified into two forms, a mode in which large numbers of ball mounts are made simultaneously in frame-shaped BGA packages and a mode in which individual ball mounts are made for each individual BGA package. In both modes, accurate positioning of the BGA package is necessary in order to mount the solder balls in a fixed position. However, in particular for the mode in which ball mounts are made individually for each BGA package, positioning and ball mounting must be effected individually and as a result, production efficiency is poor. Accordingly, a method was sought in which work positioning would be performed on multiple carriers that are aligned side by side as a means of performing positioning efficiently.

[0003] On the other hand, the technique described in Patent Gazette Publication No. H02-005039 [1990]) is a positioning means for chip sides that have been bonded and is also a means whereby positioning can be performed simultaneously on a jig board, so positioning of multiple works can be performed efficiently at the same time.

[0004] However, because positioning is performed with the upper surface of the work being adsorbed and held, this mode cannot be used in cases where solder balls are mounted on the upper surface of the work and in cases in which flux is transferred. Moreover, because the work is moved after positioning, there is the risk that slippage of the work will occur during the moving process. Therefore, it cannot be used for ball mounting of BGA packages.

[0005]

[Problems that the Invention is to Solve] This invention was developed for the purpose of solving the above-described problems and is firstly, a positioning and fixing apparatus whereby processing, such as solder ball mounting, on the upper surface of a work and the transferring of flux can be performed by housing the work on the lower surface side and effecting position alignment and fixation.

[0006] Second, it is a work positioning and fixing apparatus whereby the work is not moved after work positioning, in which the operations of fixation and processing are performed at the site, in which occurrences of slippage of the work position due to movement are prevented, and, at the same time, multiple simultaneous processing on the carrier is possible. Third, it is a work positioning and fixing apparatus of high precision that is not subject to the effects of deformation (warping, etc.) due to the fact that positioning is performed after the work has been lifted from the carrier.

[0007]

[Means of Solving the Problems] In order to solve these problems, the present invention provides a work positioning and fixing apparatus that comprises a carrier positioning and fixing apparatus and a work positioning and fixing apparatus inside the carrier, characterized in that work housing units are formed in which reference sides are provided on at least two edges thereof in the intersecting directions in the carrier, through holes are bored in the work housing units that are smaller than the work and through which the work supports can be passed and moved in the horizontal direction within a fixed range, work supports in which the other work adsorption surface is set horizontally are provided underneath the through holes of the carrier so that they can move vertically and horizontally, the work is adsorbed from underneath to the work adsorption surface as the work supports rise, the bottom surface of the work is lifted to a height that does not exceed the height of the reference sides of the work housing units, said work adsorption unit is moved in the horizontal direction in the adsorbed state so that it is pressed against at least two reference sides that are formed in the work housing units and, by bringing the work into contact with the reference sides, positioning is performed in the horizontal direction of work.

[0008]

[Embodiments of the Invention] Next is provided an explanation of the embodiments of the present invention, with reference to the drawings. Fig. 1 is an oblique view that shows a schematic of the work positioning and fixing apparatus of this invention. In this drawing, 1 is the carrier and 2 is the work. The work 2 in the embodiment shown in the drawing is a BGA package. For the purpose of the present embodiment, work 2 is limited to cases in which the external shape and the precision of positioning of the pad are superior because positioning is performed with the external shape as the standard.

[0009] The present invention is a work positioning and fixing apparatus characterized by the carrier 1 and the work supports 3 onto which the work 2 is loaded. The carrier 1 has an internal work positioning and fixing mechanism. The carrier clasper 4, which holds the carrier 1 from both sides in a lengthwise direction, as shown in Fig. 1, is used as the carrier positioning and fixing mechanism. In this drawing, 5 is a carrier positioning pin.

[0010] The carrier 1 is a plate-shaped object in which work housing units 6 are formed in the desired number (five in the embodiment shown in the drawing). The work housing units are formed as single-stage low steps from the upper surface of the carrier 1, and the reference walls 7 and 17, which serve as the positioning reference sides in the horizontal direction, are formed on the two edges that intersect on the circumference. The work housing units 6 are somewhat larger than the size of the work 2, as represented in each drawing, and are formed to an extent so that some clearance occurs when the work 2 is housed in the work housing units 6.

[0011] Through holes 8 of a size that is smaller than that of the work 2, and which make it possible for the work supports 3 to move in the horizontal direction within a specified range, are bored in the work housing units 6. In other words, the size of the through holes 8 is within a

range in which the work 2 does not fall, and elevation and descent and movement in the horizontal direction of work supports 3 is possible.

[0012] The work adsorption surface 9 is formed horizontally on the upper surface of the work supports 3 in order to ensure precision of the position in the Z axis direction and the work adsorption hole 10 that is connected with a vacuum suction apparatus not shown in the drawing is opened up. The work supports 3 are provided underneath the through holes 8 in the carrier 1, enabling movement through the through holes 8 in the vertical direction (Z axis direction) and the horizontal direction (X axis direction and Y axis direction).

[0013] Next is provided an explanation of the sequence of operations. An overview of the overall automatic solder ball mounting apparatus that is used in this invention is shown in Fig. 7. Carrier 1, which houses work 2, and which is set into carrier-supply magazine rack 20, is ejected from said magazine rack. The carrier 1 on which the work 2 is loaded is conveyed by a conveyance apparatus not shown in the drawing, such as a sending conveyor. At this point, the conveyance apparatus inserts a carrier positioning pin not shown in the drawing into the hole 5 for the carrier positioning pin on the carrier 1.

[0014] The carrier 1 is stopped on top of the carrier positioning unit 22 of the ball mounting unit 21 and is affixed by carrier clamp 4. In this manner, the carrier 1 is positioned and affixed in a precise position. In this state, as shown in the partial cross-sectional view of Fig. 2, the work supports 3 are lowered to a position that is below the carrier 1.

[0015] Next, the work supports 3, which are provided on the carrier positioning unit 22, rise as suction begins and the work adsorption surface 9 is brought into contact with the bottom surface of the work 2, which consists of individual BGA packages. It is adsorbed to the work adsorption surface 9 by vacuum adsorption and further elevated and the work 2 is lifted from the work housing units 6 on the carrier 1. The height in which it is lifted is the height at which the bottom surface of the work 2 does not extend beyond the reference walls 7 and 17 of the work housing units 6. The partial cross-sectional view in Fig. 3 shows this state.

[0016] After the work 2 has been lifted, the work supports 3 move in the X axis direction within the horizontal direction (at the top side indicated in Fig. 4), as shown in the partial plane view in Fig. 4. As a result of the movement of the work supports 3 in the X axis direction, the side surface of the work 2 in the X axis direction (the side surface of the work 2 as indicated at the top side in Fig. 4) comes into contact with the reference wall 7, which is one of the reference sides. The arrow in Fig. 4 shows the movement of work supports 3, and, in turn, the movement of the work 2.

[0017] Following that, the work supports 3 move in the Y axis direction, while maintaining the position of the X axis direction. As shown in the partial plane view of Fig. 5, as a result of the movement of the work supports 3, the side surface of the moving work 2 in the Y axis direction (the side surface on the right in Fig. 5) comes into contact with the reference wall 17, which is the other reference side. In this manner, the positioning of the work 2 in the horizontal directions of the X axis direction and the Y axis direction is performed. At this point, when there are multiple works 2 as shown in Fig. 1, positioning is performed simultaneously.

[0018] There are situations in which the positioning of the work 2 along the X and Y axes is performed independently in the direction of the respective axes. More specifically, to explain the movement in terms of work 2, according to the location before positioning, the positioning along the X axis is performed first, after which, positioning is performed whereby the apparatus returns to the centers of work housing units 6, while maintaining the degree of parallelism with the reference wall 7, and next, positioning along the Y axis direction is performed, and finally the

apparatus returns to the centers of the work housing units 6 while maintaining the degree of parallelism with the reference wall 17.

[0019] After the positioning of the work 2, flux is transferred in an unaltered state and processing, such as the mounting of the solder ball, is performed. The ball mount 21 that performs these processes is shown in Fig 8. For the ball mount 21, according to the example in the drawing, the ball mount head 24 and transfer unit 25 are placed so that they slide freely on the guide rail 23 that is provided above in the direction that is orthogonal to the direction of conveyance. The transfer unit 25 supplies the flux from the flux supply unit 26 and descends after moving to the top of the work 2, with the flux being transferred to the work 2. The solder ball mount and ball mount head 24 suction a solder ball from the solder ball supply unit 27 and move it to the top of the work 2, after which they descend and the solder ball is mounted in the work 2.

[0020] Work 2 may become positioned in a position that is lower than the top surface of the carrier 1, depending upon the depth and the shape of the work housing units 6. In such a case, because processing such as ball mounting cannot be performed on the upper surface of the work 2, after positioning of the work 2 has been concluded, an operation is necessary in which the work supports 3 are raised again and the upper surface of the work 2 is invariably shifted to a fixed position that is higher than the upper surface of the carrier 1. Fig. 6 shows this realigned position.

[0021] After the specified processing finishes, the work supports 3 descend and the work 2 is returned to the work housing units 6 of the carrier 1. Immediately before the work 2 is returned to the work housing units 6, vacuum suctioning of the work supports 3 is stopped and the work 2 assumes a state in which it is easily ejected from the work adsorption surface 9. The carrier 1 is carried by a conveyance apparatus that is not shown in the drawing and is held in the storage magazine rack 28 to complete the cycle.

[0022]

[Effects of the invention] According to the present invention, the work 2 is adsorbed to the work adsorption surface 9 of the work supports 3 that are formed horizontally, wherein the work 2 is lifted from the carrier 1 and positioning and fixing is performed, so the effects of warping and of slanting of the carrier 1 that are produced by conveyance can be avoided and the work 2 can be made horizontal.

[0023] According to the present invention, the work 2 is brought into contact with the reference sides (the reference walls 7 and 17 in the embodiment) that are formed in the work housing units 6 of the carrier 1 and positioning of the work 2 is performed along the X axis and the Y axis, so no other member other than the carrier 1 is needed for positioning and positioning can be performed inside of carrier 1.

[0024] According to the present invention, the work supports 3 adsorb and affix the bottom surface of the work 2, so the upper surface of the work 2 is open, a solder ball can be mounted on and provisionally attached to the upper surface of the work 2, and processing, such as solder ball mounting and flux transfer, can be performed to fixed locations.

[Brief Explanation of the Drawings]

[Fig. 1] A schematic diagram that shows an overall view of the work positioning and fixing apparatus

[Fig. 2] A partial cross-sectional view showing the descent of the work supports

[Fig. 3] A partial cross-sectional view showing the ascent of the work supports

[Fig. 4] A partial cross-sectional view showing the movement of the work supports in the X axis direction

[Fig. 5] A partial cross-sectional view showing the movement of the work supports in the Y axis direction

[Fig. 6] A partial cross-sectional view of the re-ascent of the work supports

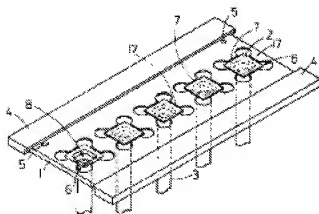
[Fig. 7] An explanatory view that shows the flow of the work in an automatic ball mounting apparatus

[Fig. 8] An overall oblique view that shows the ball mount unit

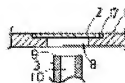
[Explanation of Symbols]

- 1 Carrier
- 2 Work
- 3 Work supports
- 4 Carrier clasper
- 5 Pinhole
- 6 Work housing units
- 7, 17 Reference walls
- 8 Through holes
- 9 Work adsorption surfaces
- 10 Work adsorption holes

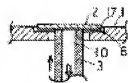
[Fig. 1]



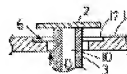
[Fig. 2]



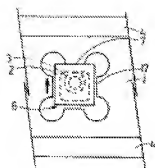
[Fig. 3]



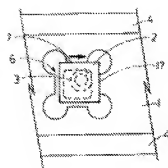
[Fig. 6]



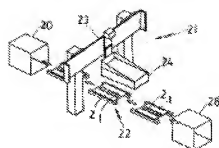
[Fig. 4]



[Fig. 5]



[Fig. 7]



[Fig. 8]

